

CLAIMS

1. An exhaust purification device for an internal combustion engine having, a NO<sub>x</sub> storing catalyst arranged in an engine exhaust passage, the NO<sub>x</sub> storing catalyst  
5 being comprised of a precious metal catalyst and a NO<sub>x</sub> absorbent and, when an air-fuel ratio of inflowing exhaust gas is lean, cold storing nitrogen dioxide NO<sub>2</sub> contained in the exhaust gas in the NO<sub>x</sub> absorbent when not activated and hot storing cold stored nitrogen  
10 dioxide NO<sub>2</sub> in the NO<sub>x</sub> absorbent when activated,

said exhaust purification device for an internal combustion engine making the nitrogen dioxide NO<sub>2</sub> contained in the exhaust gas be cold stored in the NO<sub>x</sub> absorbent in the state where said NO<sub>x</sub> storing  
15 catalyst is not activated and executing a NO<sub>x</sub> storing catalyst restoring control including at least raising the temperature of said NO<sub>x</sub> storing catalyst to a predetermined temperature to activate it when a predetermined NO<sub>x</sub> storing catalyst restoring condition is  
20 met so as to restore the cold storing capability of said NO<sub>x</sub> absorbent in the state where said NO<sub>x</sub> storing catalyst is not activated.

2. An exhaust purification device as set forth in claim 1, wherein said NO<sub>x</sub> storing catalyst restoring  
25 condition is set to be met before the cold storing capability of said NO<sub>x</sub> absorbent in the state where said NO<sub>x</sub> storing catalyst is not activated is saturated.

3. An exhaust purification device as set forth in claim 1, wherein said NO<sub>x</sub> storing catalyst restoring  
30 condition is set so that the cold stored nitrogen dioxide NO<sub>2</sub> will not be released from said NO<sub>x</sub> absorbent in more than a predetermined amount when raising the temperature of and activating said NO<sub>x</sub> storing catalyst in said NO<sub>x</sub> storing catalyst restoring control.

35 4. An exhaust purification device as set forth in claim 1, wherein

said device has a NO<sub>2</sub> stored amount

estimating means for estimating an amount of nitrogen dioxide NO<sub>2</sub> cold stored in said NO<sub>x</sub> absorbent and a NO<sub>x</sub> storable amount estimating means for estimating an amount of nitrogen oxides NO<sub>x</sub> able to be stored in said NO<sub>x</sub> absorbent when said NO<sub>x</sub> storing catalyst is at said predetermined temperature and

said NO<sub>x</sub> storing catalyst restoring condition is deemed to be met when the NO<sub>2</sub> stored amount estimated by said NO<sub>2</sub> stored amount estimating means becomes greater than or equal to a predetermined amount set to not more than said NO<sub>x</sub> storable amount based on the NO<sub>x</sub> storable amount estimated by said NO<sub>x</sub> storable amount estimating means.

5. An exhaust purification device as set forth in claim 1, wherein

said NO<sub>x</sub> storing catalyst is a NO<sub>x</sub> storing catalyst having the function of hot storing nitrogen oxides NO<sub>x</sub> contained in exhaust gas in the NO<sub>x</sub> absorbent when said NO<sub>x</sub> storing catalyst is activated and the air-fuel ratio of the exhaust gas flowing into the NO<sub>x</sub> storing catalyst is lean,

said device has a NO<sub>x</sub> release speed estimating means for estimating a release speed of nitrogen oxides NO<sub>x</sub> from said NO<sub>x</sub> absorbent when making said NO<sub>x</sub> storing catalyst said predetermined temperature and a NO<sub>x</sub> storing speed estimating means for estimating a storing speed of nitrogen oxides NO<sub>x</sub> to said NO<sub>x</sub> absorbent when making said NO<sub>x</sub> storing catalyst said predetermined temperature, and

said NO<sub>x</sub> storing catalyst restoring condition is deemed to be met when the NO<sub>x</sub> release speed estimated by said NO<sub>x</sub> release speed estimating means becomes greater than or equal to a predetermined speed set to not more than said NO<sub>x</sub> storing speed based on the NO<sub>x</sub> storing speed estimated by said NO<sub>x</sub> storing speed estimating means.

6. An exhaust purification device as set forth in

claim 1, wherein

said NO<sub>x</sub> storing catalyst is a NO<sub>x</sub> storing catalyst having the function of hot storing nitrogen oxides NO<sub>x</sub> contained in exhaust gas in the NO<sub>x</sub> absorbent when said NO<sub>x</sub> storing catalyst is activated and the air-fuel ratio of the exhaust gas flowing into the NO<sub>x</sub> storing catalyst is lean,

said device has a NO<sub>x</sub> release speed estimating means for estimating a release speed of nitrogen oxides NO<sub>x</sub> from said NO<sub>x</sub> absorbent when making said NO<sub>x</sub> storing catalyst said predetermined temperature, a NO<sub>x</sub> exhaust speed estimating means for estimating an exhaust speed of nitrogen oxides NO<sub>x</sub> from the internal combustion engine, and a NO<sub>x</sub> storing speed estimating means for estimating a storing speed of nitrogen oxides NO<sub>x</sub> to said NO<sub>x</sub> absorbent when making said NO<sub>x</sub> storing catalyst said predetermined temperature, and

said NO<sub>x</sub> storing catalyst restoring condition is deemed to be met when a sum of the NO<sub>x</sub> release speed estimated by said NO<sub>x</sub> release speed estimating means and the NO<sub>x</sub> exhaust speed estimated by said NO<sub>x</sub> exhaust speed estimating means becomes greater than or equal to a predetermined speed set to not more than said NO<sub>x</sub> storing speed based on the NO<sub>x</sub> storing speed estimated by said NO<sub>x</sub> storing speed estimating means.

7. An exhaust purification device as set forth in claim 1, wherein

said NO<sub>x</sub> storing catalyst has the function of releasing, reducing, and purifying the nitrogen oxides NO<sub>x</sub> which had been hot stored in the NO<sub>x</sub> absorbent when said NO<sub>x</sub> storing catalyst is activated and when making the air-fuel ratio of the exhaust gas flowing into the NO<sub>x</sub> storing catalyst smaller and establishing the presence of a reducing agent in state, and

said NO<sub>x</sub> storing catalyst restoring control includes making the air-fuel ratio of the exhaust

gas flowing into the NO<sub>x</sub> storing catalyst smaller and establishing the presence of a reducing agent in state.

5        8.    An exhaust purification device as set forth in claim 1, further having a NO<sub>2</sub> ratio increasing means for increasing a ratio of nitrogen dioxide NO<sub>2</sub> with respect to nitrogen monoxide NO produced at the time of combustion under a lean air-fuel ratio when said NO<sub>x</sub> storing catalyst is not activated compared with when the NO<sub>x</sub> storing catalyst is activated in the same engine  
10        operating state.

          9.    An exhaust purification method for an internal combustion engine including, arranging a NO<sub>x</sub> storing catalyst in an engine exhaust passage, the NO<sub>x</sub> storing catalyst being comprised of a precious metal catalyst and  
15        a NO<sub>x</sub> absorbent and, when an air-fuel ratio of inflowing exhaust gas is lean, cold storing nitrogen dioxide NO<sub>2</sub> contained in the exhaust gas in the NO<sub>x</sub> absorbent when not activated and hot storing cold stored nitrogen dioxide NO<sub>2</sub> in the NO<sub>x</sub> absorbent when activated,  
20                making the nitrogen dioxide NO<sub>2</sub> contained in the exhaust gas be cold stored in the NO<sub>x</sub> absorbent in the state where said NO<sub>x</sub> storing catalyst is not activated and raising the temperature of said NO<sub>x</sub> storing catalyst to a predetermined temperature to activate it so  
25        as to restore the cold storing capability of said NO<sub>x</sub> absorbent in the state where said NO<sub>x</sub> storing catalyst is not activated before the cold storing capability of said NO<sub>x</sub> absorbent in the state where said NO<sub>x</sub> storing catalyst is not activated is saturated.